Impact of the Stochastic Behaviour of Renewable Resources on Power System Reliability

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Carbon Emissions → Clean Energy

Widespread development of renewable energy technologies in power system networks promises to substantially improve energy efficiency, economy and consumption.

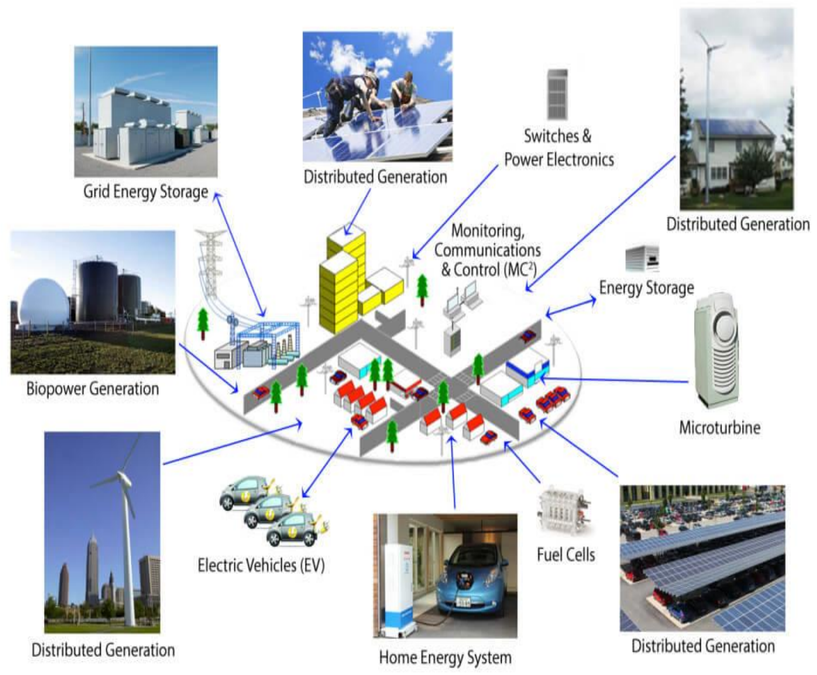
This is expected to improve climate by reducing carbon emissions and promoting a clean energy future.

Spatial and Temporal Variability

Unpredictability of solar irradiance and wind profiles, failure rates of associated equipment and consumers' energy-use patterns creates substantial uncertainty about the impact on reliability.

Smart Grid Functionality

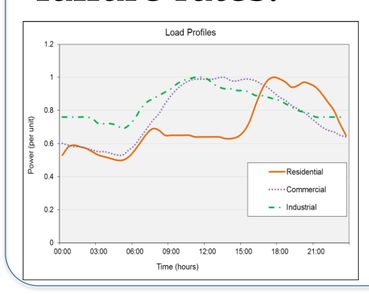
Intelligent implementation of 'smart grid' network functionality will improve the quality of supply experienced by the end customers.

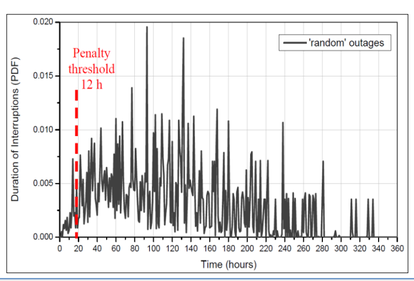


Renewable-based small-scale generation technologies allow for the deferral of (usually exorbitant) capital investment for network area reinforcement.

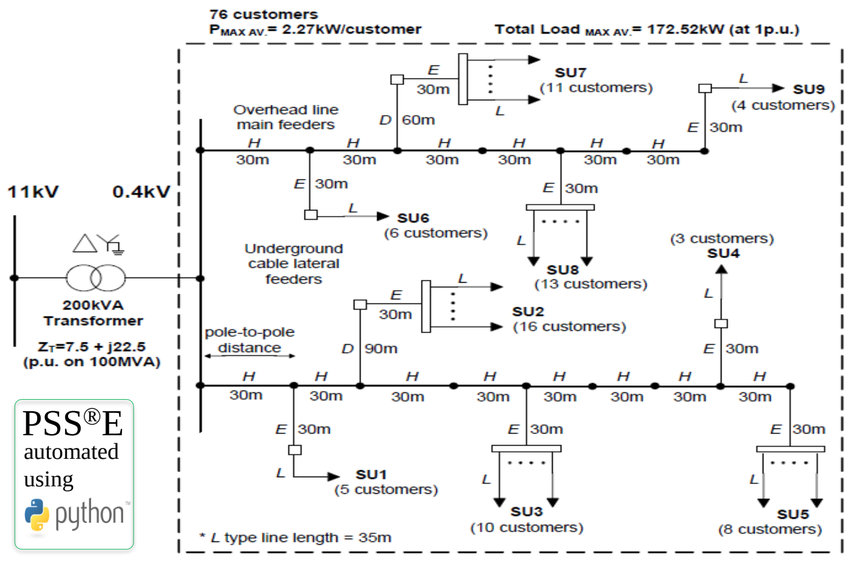
Methodology – Integrated Quality of Supply Analysis

Improving conventional **Monte-Carlo simulation** (using MATLAB) by including time-variation of electricity demand profiles and power components' failure rates.





Suburban distribution network



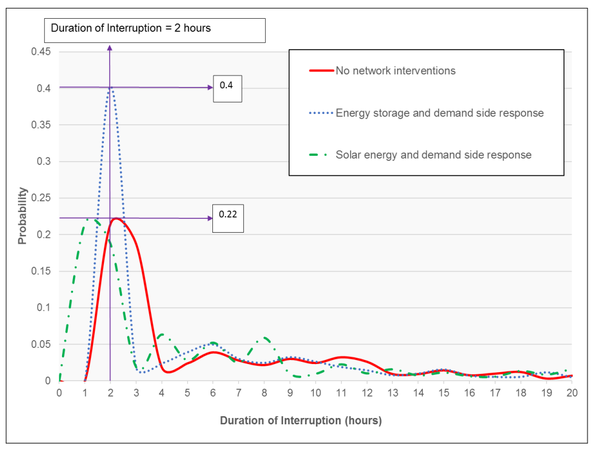
PSS®E automated using python

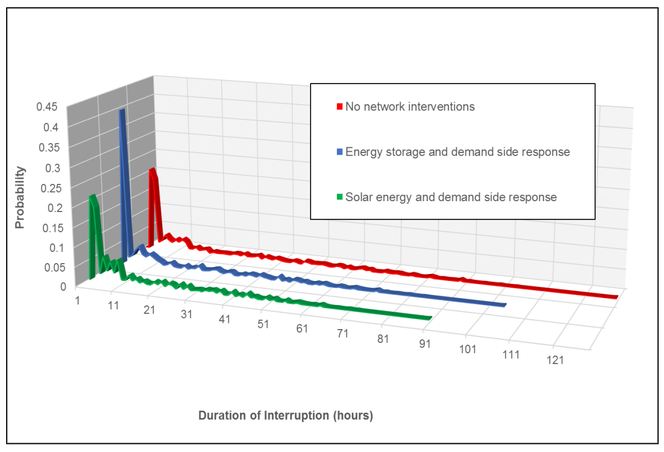
Calculate standard **reliability performance indices** – assessing frequency and duration of interruptions, energy not supplied, etc.

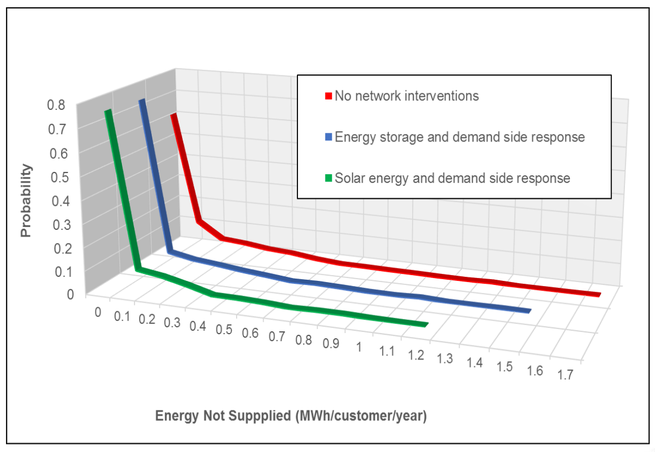
Model different

'smart' interventions

Results and Conclusions







Reductions in the frequency and duration of **interruptions, and energy not supplied**

Impact on duration of interruptions and energy not supplied

Fast-track development of planning and operation tools (integrating system reliability) **to increase energy efficiency** and most importantly, **save on energy cost**.

Further work will integrate power quality into the analysis and quantify the commercial benefits.

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